

I. OUTLINE

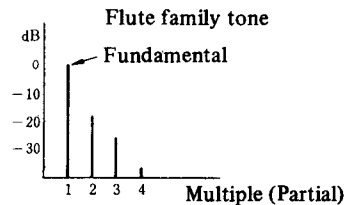
1. TONE COLORS OF NATURAL INSTRUMENTS

1. OUTLINE

1-1. Tone colors of natural musical instruments

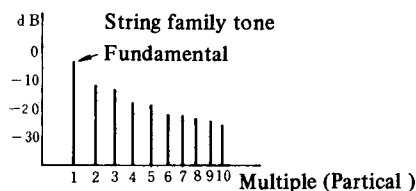
Such natural musical instruments as trumpets and violins produce their own characteristic sounds. Among the factors which determine these unique musical tone colors, the one that plays the most important role is called the component harmonic tone. In other words, the differences between those tone colors are determined by the kind and degree of harmonic components which constitute the particular sound produced from a particular musical instrument. The construction of harmonic tones by a natural musical instrument is diverse and complex and cannot be easily described. They are, however, roughly classified into the following three categories into which the sounds of any musical instrument can be classified.

- 1) A harmonic structure consisting of the fundamental tone and low degree of harmonic overtones with a waveform resembling sine wave. The tone color is mellow and clear. For example, the flute tones belong mainly to this category (see fig. 1).



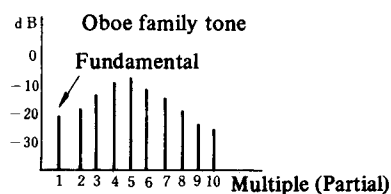
[fig. 1]

- 2) A harmonic structure, consisting of the fundamental tone and many integral harmonic overtones, with the higher harmonics less weak in relation to the fundamental or lower harmonic compared to category (1) above. This tone color waveform corresponds to an asymmetric rectangular and a sawtooth, lending brilliance and delicacy to the sound. The sounds of string instruments for example, belong to this category (see fig. 2).

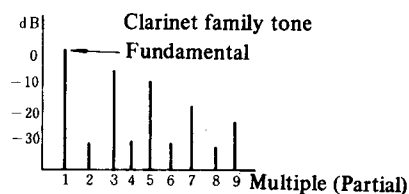


[fig. 2]

- 3) A harmonic structure consisting of particular harmonic overtone components which are partially emphasized, and which produce a tone color waveform, sawtooth in shape or similar to a rectangular. Its tone colors are distinct, such as rich, full sounds, muffled sounds or vibrant sounds. For instance, the sounds created by the oboe or clarinet fall mainly into this category (see figs. 3 and 4).



[fig. 3]



[fig. 4]

Note: The tone color of a natural musical instrument is also determined by various other factors, i.e., pitch, volume and the temporal change of the harmonic overtones.

2. HOW TONE COLORS ARE CREATED IN A PAS SYSTEM ELECTONE ORGAN

In general, tone color variety has been achieved in the past by a tone color circuit using one kind of tone source waveform, which corresponds to the number of the keyboard switches. But to have the only one kind of tone source waveform predetermines the volume of the harmonics which form the basis of the tone color, hence limiting the possibility of recreating tones of natural musical instruments with complex harmonic components. That is why this PAS system Electone organ has been developed.

By using a PAS system, four different kinds of sound source waveforms (sine wave, square wave, sawtooth wave and asymmetric rectangular wave) are produced simultaneously, each with a unique harmonic structure of its own, when the keyboard switch is pressed. At the same time, colorful and richer sounds can be created by processing each sound source waveform through two kinds of tone color system (a synthesizing system and a filter system), each of which has its assets, depending upon the sound source waveform.

3. PAS SYSTEM ELECTONE ORGAN CLASSIFICATION.

There are two categories of Electones featuring this PAS system, distinguished by the tone color producing circuit.

1. PAS-VCF

This PAS system electone produces Flute voices (Attack and Flute tone) through a sine wave synthesizing system (PAS system), which it also creates Orchestra voices (Preset tones) using a Voltage Control Filter (VCF) similar to a musical synthesizer. Models E-50 and up, including the upper keyboard orchestra tones of E-30 and the pedals orchestra tones of D-80.

2. PAS-FORMANT

A PAS system organ which creates flute voices through an sine wave synthesizing system (PAS system), while creating other voices (Oboe and String tones except Flute voices) using the fixed filter (Formant) found in existing Electones. Models E-30 and below, except the UK orchestra tones of E-30, and the PK orchestra tones of D-80.

4. CHARACTERISTICS OF THE PAS SYSTEM.

- Creates more natural flute tones.
- PAS-VCF models are capable of making fuller sounds by varying the length of time of the note, and the volume, as is done in the GX-1.
- By using a multiple number of harmonic waveforms according to each voice, more natural tone colors can be made.
- Sustain effect can be applied to all the tones produced by couplers (tone levers).
It provides separate vibrato effects to upper and lower keyboards. Also it provides delay vibrato effect to each of upper keys.
- It is possible to have several couplers (such as 16', 8', 4', etc.) with single contact switches.
- It comes with a number of features to create richer music performances. Celeste, Auto Arpeggio, etc.

5. THE NUMBER OF TONES PRODUCED BY THE KEYBOARDS.

Electones featuring the PAS system have certain limitations in the number of sounds which can be created from the upper and lower keyboards.

- **The Number of Basic tones for Upper and Lower Keyboards**

Basically, number of possible tones created on upper and lower keyboards are eleven.

When Orchestra tone is set, number of possible tones on either upper or lower keyboard are seven, summing up eleven tones together with additional four Flute tones.

- a) The Number of basic tones for Flute voices and PAS-FORMANT Types

[fig. 5]

Number of basic tones of first key pressed		Number of available tones produced by keys pressed later
Number pressed	Number of basic sounds produced	
UK : 5	: 5	LK : Up to six
UK : 11	: 11	LK : No sound
LK : 9	: 9	UK : Up to two
LK : 11	: 11	UK : No sound
UK : 15	: 11	LK : No sound

- b) Number of basic tones for Orchestra (up to 7 tones on a single keyboard)

[fig. 6]

Number of basic tones of first key pressed		Number of available tones produced by keys pressed later
Number pressed	Number of basic sounds produced	
UK : 5	: 5	LK : Up to six
UK : 8	: 7	LK : Up to three
UK : 11	: 7	LK : No sound
LK : 6	: 6	UK : Up to five
LK : 9	: 7	UK : Up to two
LK : 11	: 7	UK : No sound
LK : 13	: 7	UK : No sound

- **The Number of Tones Produced by the Pedals**

Regardless of upper and lower keyboards, only one pedal tone sounds at a time. High tone takes precedence.

II. EXPLANATION OF FUNCTION (PAS-VCF MODEL E-70)

1. SPECIFICATIONS

• KEYBOARDS

UK : 61 keys (C₁ - C₆)

LK : 61 keys (C₁ - C₆)

PK : 25 keys (C₀ - C₂)

• VOICES

(note: D = Percussive tone, Damped tone)

a) Flute family tones (tone levers)

UK : Attack, 4', 2-2/3', 2'

Flute, 16', 8', 5-1/3', 4', 2-2/3', 2',
1-3/5', 1-1/3', 1'

LK : Attack, 4', 2'

Flute, 16', 8', 4', 2-2/3', 2'

PK : Bass, 16', 8', 4'

b) Preset tone (lever switch)

UK climes (D)

vibraphone (D)

c) Orchestra tone (button switch)

UK

1	3	5	7	9	11	13	15	17
2	4	6	8	10	12	14	16	18

- | | |
|--------------|-------------------------|
| 1. Flute | 10. String |
| 2. Clarinet | 11. Piano (D) |
| 3. Trombone | 12. Harpsichord (D) |
| 4. Trumpet | 13. Jazz Guitar (D) |
| 5. Post Horn | 14. Electric Guitar (D) |
| 6. Saxophone | 15. Banjo (D) |
| 7. Oboe | 16. Harp (D) |
| 8. Kinura | 17. Funny I |
| 9. Violin | 18. Funny II |

LK

1	3	5	7	9	11
2	4	6	8	10	12

- | | |
|-------------|-------------------------|
| 1. Flute | 7. Piano (D) |
| 2. Diapason | 8. Harp (D) |
| 3. Trombone | 9. Guitar (D) |
| 4. Horn | 10. Electric Guitar (D) |
| 5. Cello | 11. Funny I |
| 6. String | 12. Funny II |

PK

1	3	5	7	9	11
2	4	6	8	10	12

- | | |
|--------------------|------------------------|
| 1. Bowed Bass | 7. Piano (D) |
| 2. String Bass (D) | 8. Harpsichord (D) |
| 3. Diapason | 9. Bass Guitar I (D) |
| 4. Bass Clarinet | 10. Bass Guitar II (D) |
| 5. Tuba | 11. Funny I |
| 6. Trombone | 12. Funny II |

d) Preset voices (push pistons)

① Jazz-tone type preset (all keyboards)

② Full organ type preset (all keyboards)

③ Theater organ type preset (all keyboards)

④ UK panel setting

⑤ UK panel setting

⑥ All keyboard setting

Built into preset
board

• CONTROL LEVERS

UK : Bright, Transposition I, II (16', 8', 4', 2')

LK : Bright, Transposition I, II (16', 8', 4', 2')

PK : Bright, Transposition I, II (16', 8', 4')

• EFFECT LEVERS

Attack: Repeat (UK)
Length (UK & LK)
Vibrato: Touch (UK)
Delay (UK)
Depth (UK & LK)
Speed (UK & LK)

Attack Pitch:

ON/OFF switch (all keyboards)
Time control (all keyboards)

Percussion: Brush Cymbal (LK)
Snare Brush (LK)
Cymbal (PK)

Sustain: ON/OFF switch (all keyboards)
Length lever (UK & LK)

Celeste: Flute (UK & LK)
Bass (PK)
Orchestra (all keyboards)

Coupler: Upper Plus Lower (Orchestra)
Lower Plus Pedal

Tremolo: Flute (UK & LK)
Orchestra (UK & LK)
Tremolo
Chorus
Speed control knob

Repeat Speed (UK Orchestra)

U. Flute Percussive Decay

U & L Flute Response

Wah-Wah Flute (UK)
Orchestra (UK)

• AUTOMATIC FEATURES

AUTO RHYTHM SECTION

Rhythm Selectors

March	Waltz
Swing	Ballad
Slow Rock	Jazz Rock I
Jazz Rock II	Bolero
Tango	Beguine
Rhumba	Mambo
Bossanova	Samba
Variation	

Rhythm Controls

Rhythm Start
Rhythm Synchro-Start
Rhythm Stop (Foot Switch)
Tempo
Volume
Tone Balance
Tempo Light

ABC FUN BLOCKS

ABC Selectors

Normal
Single Finger Chord
Fingered Chord
Custom ABC
Constant

Bass Variation Selectors

Normal, 1, 2

AUTO ARPEGGIO SECTION

(LOWER)

Voice Selectors

Flute
Orchestra

Mode Selectors

Regular/ Random
Up/Turn
Synchro/Free

Octave Selector (N, O, 1, 2, 3)

Beat Selector (J J J J)

Tempo Control
Foot Switch Stop
Tempo light
Stop light

• OTHER CONTROLS

Master Volume
Brilliance
Manual Balance
Reverb
Pitch Control
Flute Volume (UK & LK)
Bass Volume (PK)
Orchestra Volume (all keyboards)
Pedal Dynamic Range Control Piston
Foot Switch Controls (Upper Glide)
(U & L Damper)
(Rhythm Stop)

• OTHER FITTINGS

Power Switch
Panel and Pedal Light and Switch
Tone Cabinet Connectors
Headphone Jack
Knee Lever
Expression Pedal
Expression Input Jack
AUX. IN. Jack
AUX. OUT. Jack

a) Speakers

Non-Tremolo

JA 3802 (38 cm) Bass Range
JA2057A(20 cm) Middle Range
JA0553 (5 cm) High Range

Tremolo

JA2061 (20 cm)

b) Power Amplifier

Non-Tremolo 60W (R.M.S. Output Power)
Tremolo 60W (—do.—)

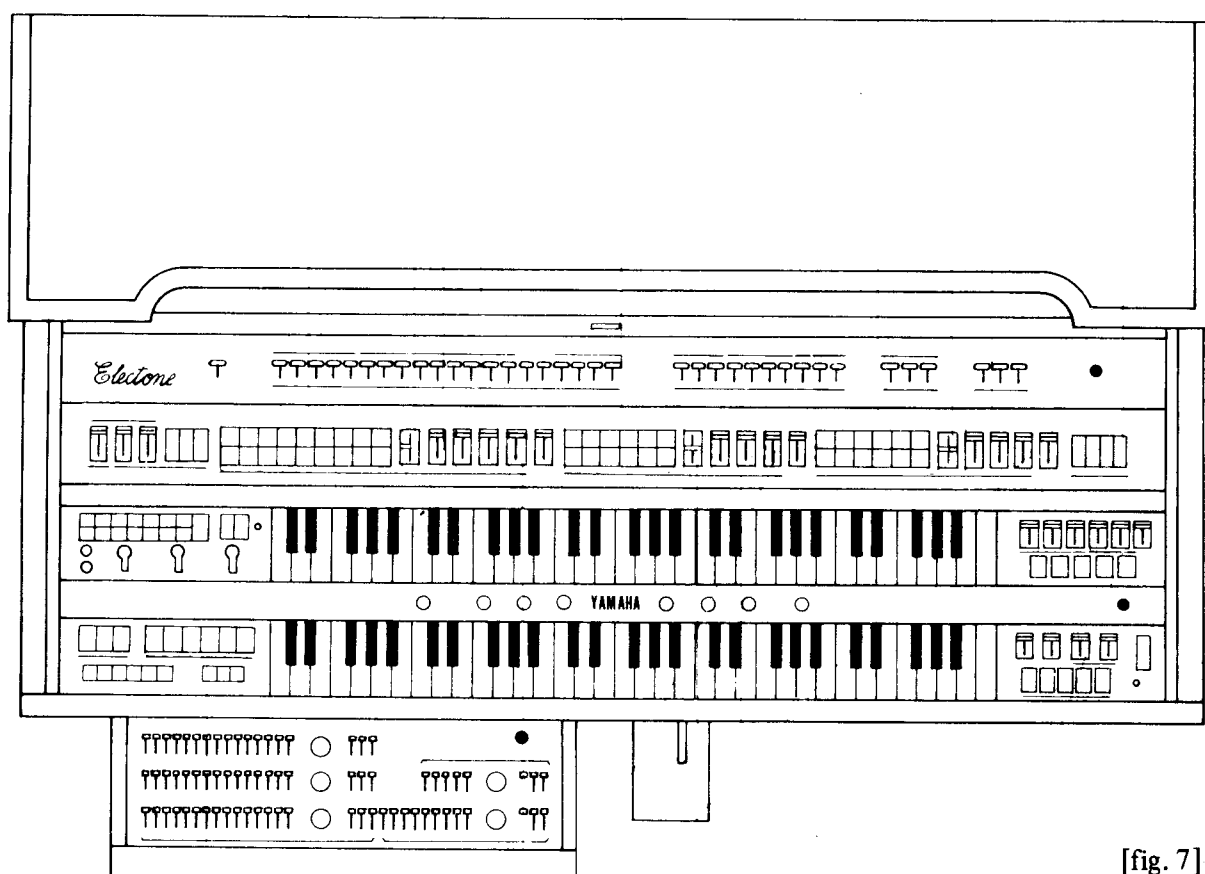
c) Power Consumption

330W (Max.)
(Nameplate indication for CSA
specifications only: 3.5A.)

• DIMENSIONS

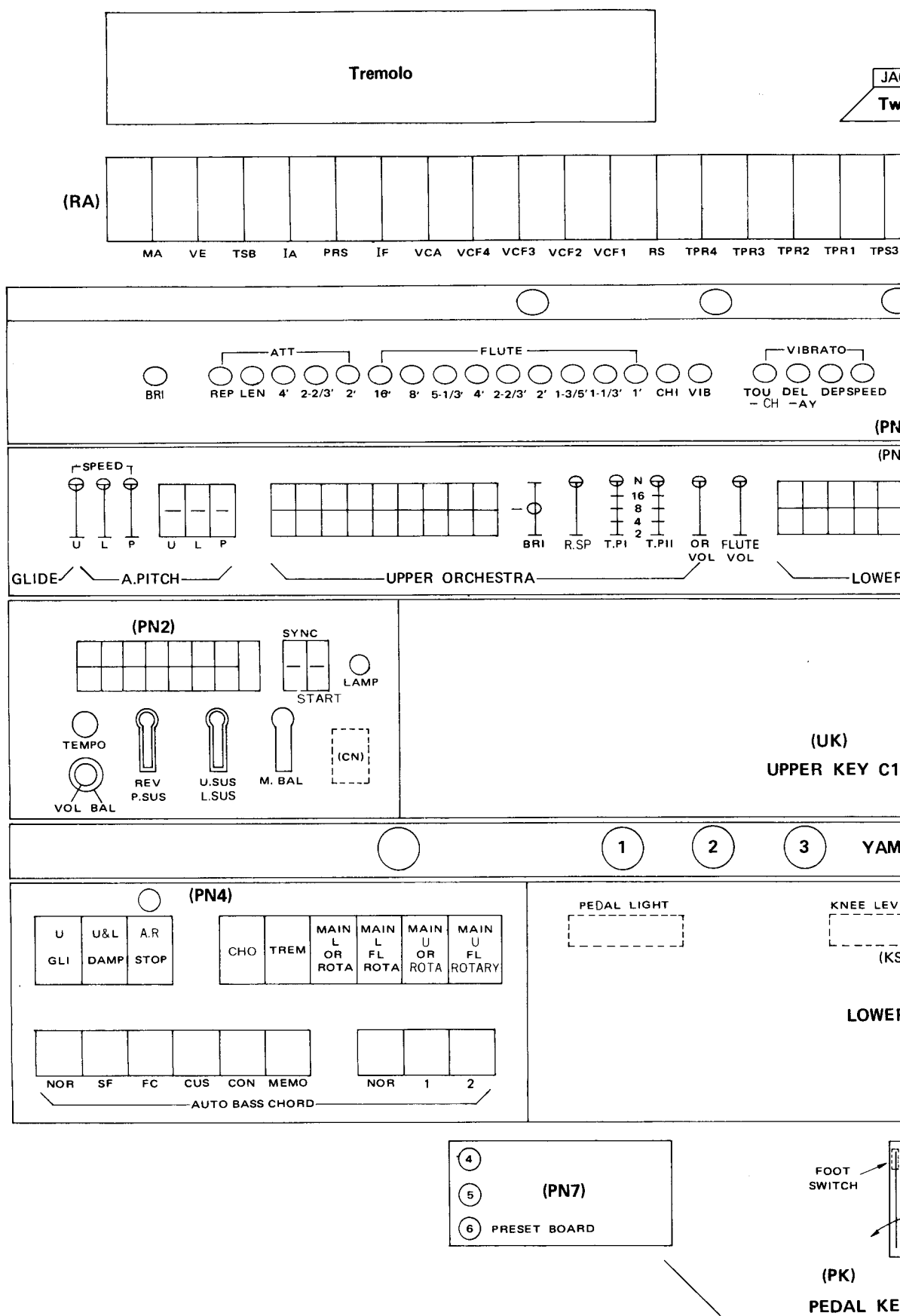
	Body	Chair	Pedal Keyboard (mm)
Width	1317	1016	1216
Depth	766	411	823
Height	1128	600	135
Weight	160 kg	16 kg	22 kg
Finish	CSP	CSP	CSP

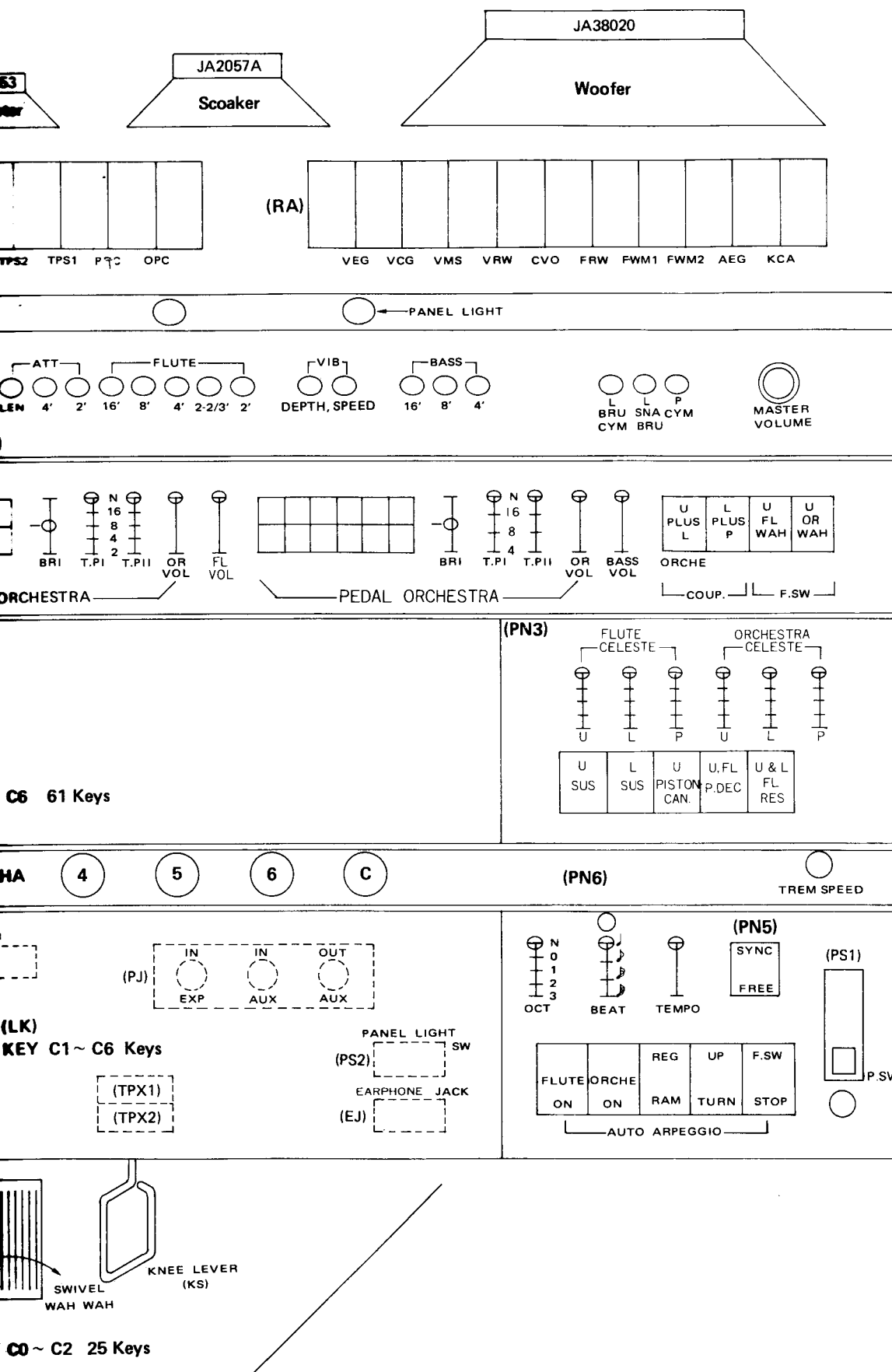
Note: Height with music stand raised: 1318 mm.



[fig. 7]

2. PANEL LAYOUT (MODEL E-70)





[fig. 8]

3. EXPLANATION OF PANELS.

PANEL (PN1)

Tone Color

Equivalent to the tone levers on present Electone organ, the tone colors roughly classified into Flute and Orchestra.

1. Flute family tone

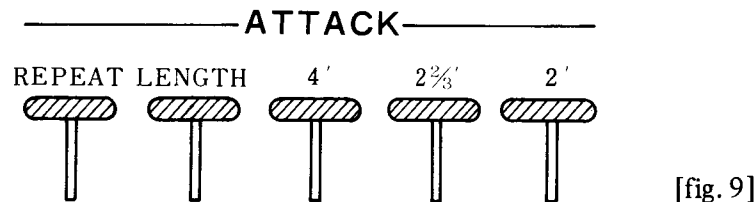
Flute tone color consists of three types, i.e., Flute, Attack tone and Preset tone. Flute and Attack tone are controlled by tone levers (Volume) and Preset tone by a lever switch. There is also a Flute Volume which controls the volume of all three.

a) Flute

A tone lever with the conventional click stops.

b) Attack Tone

Attack tone is a normal percussive tone which rises sharply as the key is pressed and immediately decays. Single notes can be obtained independently.



- **LENGTH**

This lever controls the decay time of Attack tone, over a range of approximately 30 ms to 1 s. The further the lever is pulled, the longer the decay time becomes.

- **REPEAT**

Repeats the Attack tone as long as the key is pressed, creating crisp intermittent sounds. The length of repetition is controlled by the length lever. The further the lever is pulled, the faster it becomes. When more than two keys are pressed at the same time, it repeats each sound independently.



c) **Preset Tone**

• **CHIMES**

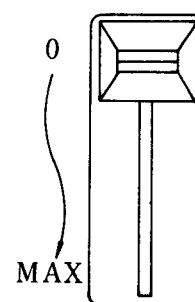
Using the tone color of Flute 4', the note of the depressed key (4'), minor 6th lower (6-2/5'), perfect fifth higher (2-2/3') and one octave higher (2') are produced simultaneously, and they decay within a certain length of time whether or not the key is held down.

• **VIBRAPHONE**

The tone of Flute 8' with sine wave amplitude modulation (degree of modulation 30 - 50%). The instant the key is depressed, the 2' Attack tone joints and decays while the key is still depressed. Sustain is controlled by the Damper.

d) **Flute Volume**

This is a slider to control the volume of all the levers for the Flute tone.

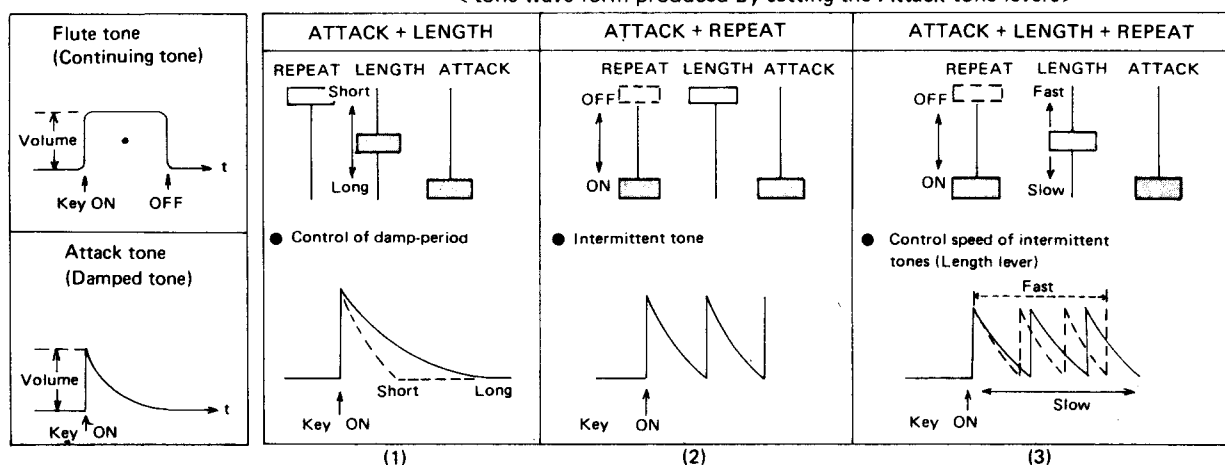


[fig. 11]

Note: Order of priority within the Flute tone (example: $a < b$ means priority is given to b)

FLUTE
ATTACK < CHIMES < VIBRAPHONE

< tone wave form produced by setting the Attack tone levers >



[fig. 12]

2. Orchestra tone

Each of the Orchestra tones is selected by the corresponding button-switch, but two or more tones cannot be used at the same time.

(1) Tone Priority:

A	C	E	G	I	K	M
B	D	F	H	J	L	N

When there are selection button as above.

$A < B < C < D \quad \sim \quad L < M < N$

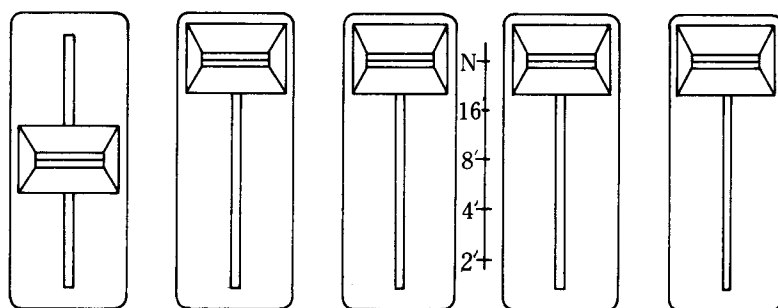
I.e., priority is to the right and bottom, so that N is dominate. When the buttons are pressed one by one, the tone of the button pressed later sounds and the tone previously pressed is automatically cancelled.

Note: When power is switched on, the tone of A (Flute) sounds.

(2) Control Levers for Orchestra Tone

The functions to control Orchestra tones are:

- Bright (center click slider)
- Repeat speed (slider)
- Transposition I, II (5-stage switch)
- Orchestra volume (slider)

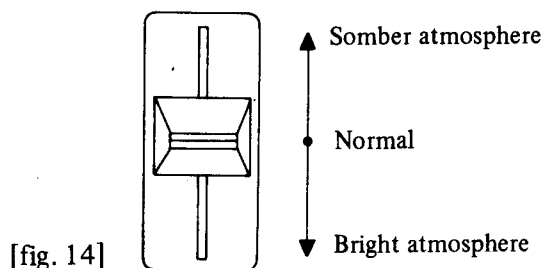


BRIGHT REPEAT SPEED I-TRANS POSITION-II VOLUME [fig. 13]

a) BRIGHT

This effect makes the whole Orchestra tone brilliant or somber. The lever actually controls how many overtones are contained in the tone. Its normal position is the central click stop.

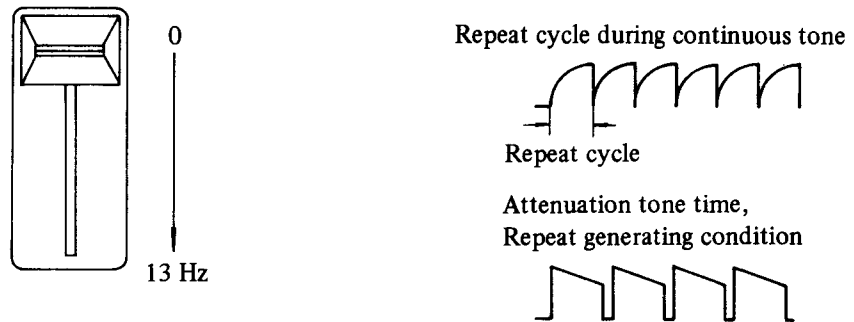
Note: String type tones require less change compared with other types of tones.



[fig. 14]

b) Repeat Speed

This effect is different from conventional repeat speed. It appears to switch the tone on and off when an upper key is pressed. It begins as soon as the lever is turned on, and full setting provides a 13 Hz switching rate.

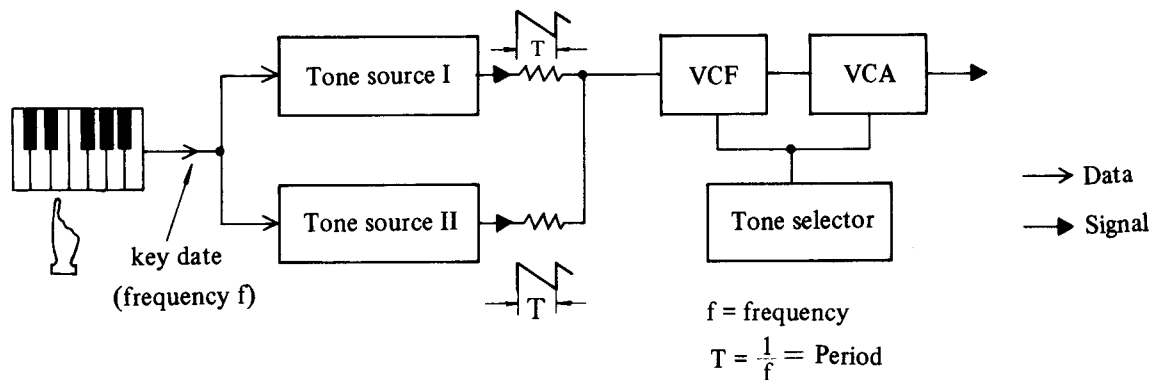


[fig. 15]

c) Transposition I, II

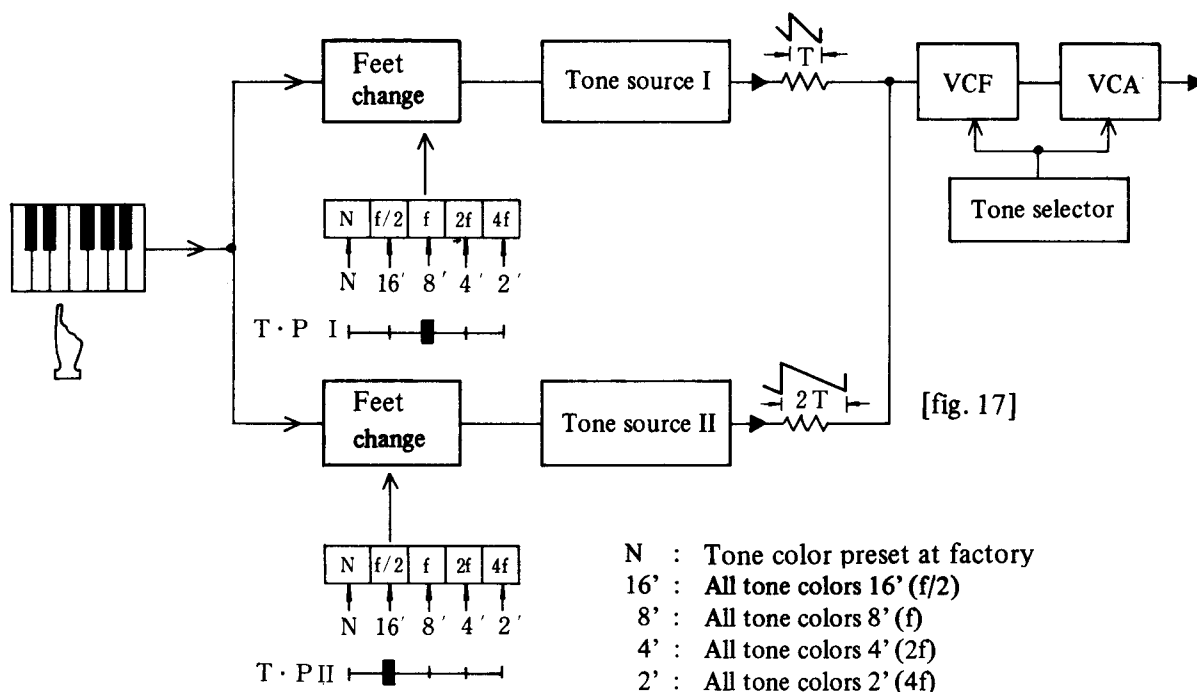
Transposition uses octave switching levers. If Transposition lever is used, then each key sounds are an octave higher. With Orchestra tone, each key has two tone source circuits (forming the tone source waveform and interval); which have exactly same function.

Ordinarily, when a key is pressed these two tone source circuits begin to function at the same time, and each forms exactly the same pitch tones corresponding to the pressed key; these are mixed into one tone.



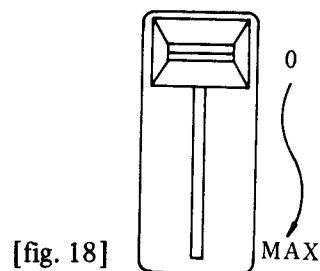
[fig. 16]

If the pitches of these two tone source circuits are not set exactly the same, two differently pitched tones will sound when a single key is pressed (coupler). The Transposition I and II levers can be used to make the tones produced in these two tone source circuits take on different octave relations (i.e., different "feet" count) for the pressed key.



Note) At N position, trombone, saxophone, jazz guitar, and electric guitar are set for 16' and the rest for 8'.

- d) Orchestra Volume
This lever is used to control the volume of the Orchestra tone (slide control).



* Overall Tone Priority

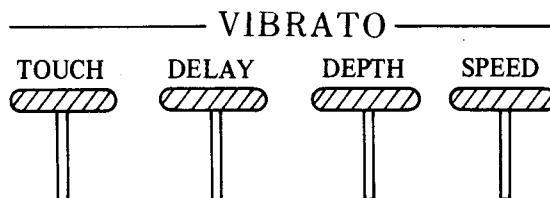
FLUTE
ATTACK } <PRESET TONE } <PRESET VOICE (PISTON)
ORCHESTRA

As the above graph shows, an ensemble effect combining Flute and Orchestra tones is possible, but Preset Voices (Pistons) are given precedence when pressed.

Vibrato

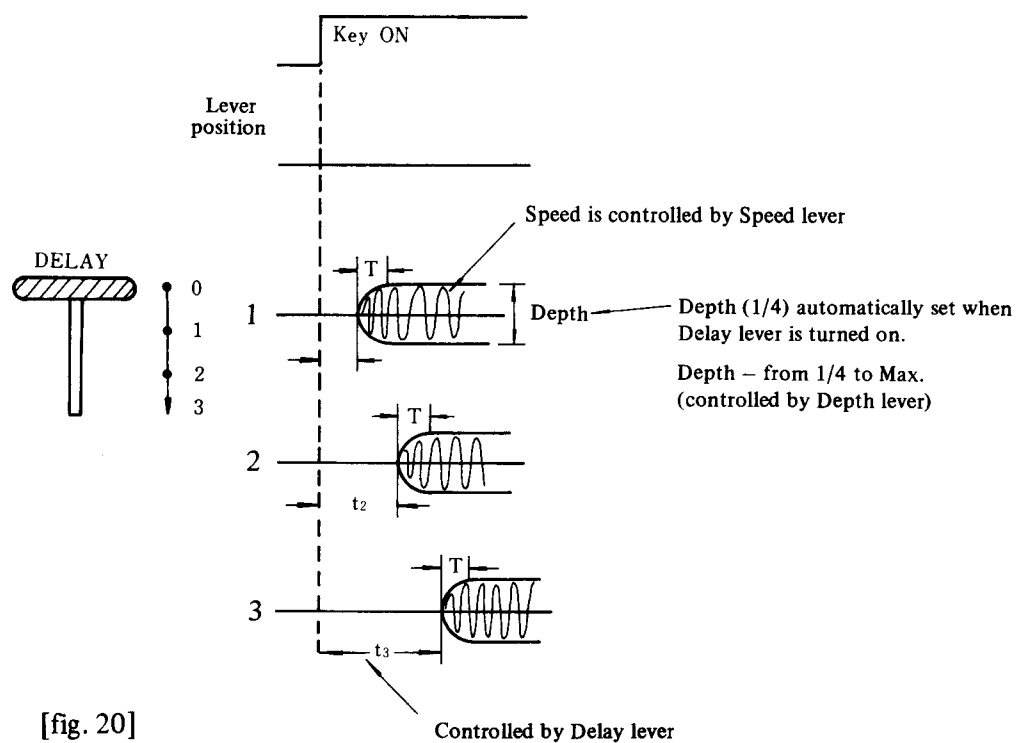
The Vibrato effect, which causes tones to vibrato by raising and lowering the pitch in short cycles, can be applied separately to upper and lower keyboards, or both. Divided according to functions, vibrato can be classified into the following three types.

- a . TOUCH VIBRATO
- b . NORMAL VIBRATO
- c . DELAY VIBRATO



[fig. 19]

- a) Touch Vibrato
Same as conventional touch vibrato effect and controls
 - * "Depth" is set by Touch Vibrato lever
 - * "Depth and Speed" by horizontal movement of the key (hand).However, if either the Delay lever or Depth lever is even slightly on, the Touch Vibrato effect will be cancelled.
- b) Normal Vibrato
Same as conventional normal Vibrato effect and controls.
 - * "Depth" is set by the Depth lever
 - * "Speed" by the Speed lever
- c) Delay Vibrato
Delay Vibrato provides a vibrato effect which starts only after a certain delay from the instant the key is pressed. The Delay lever controls the time (t) required for the vibrato effect to begin after the key is pressed. Depth and speed can be controlled by Depth and Speed levers respectively. However, even if the Depth is not turned on, when the Delay lever is on the effect operates as if the Depth lever is set to 1/4 of its maximum position.



[fig. 20]

Note: $t_1 < t_2 < t_3$ (t : time required for vibrato to work after key-on)
 T = fixed (time required to completely achieve fixed depth after vibrato begins to function).

d) Priority order for each Vibrato function

Priority order is:

Touch Vibrato < Normal Vibrato < Delay Vibrato

i.e., Delay Vibrato takes precedence over the others.

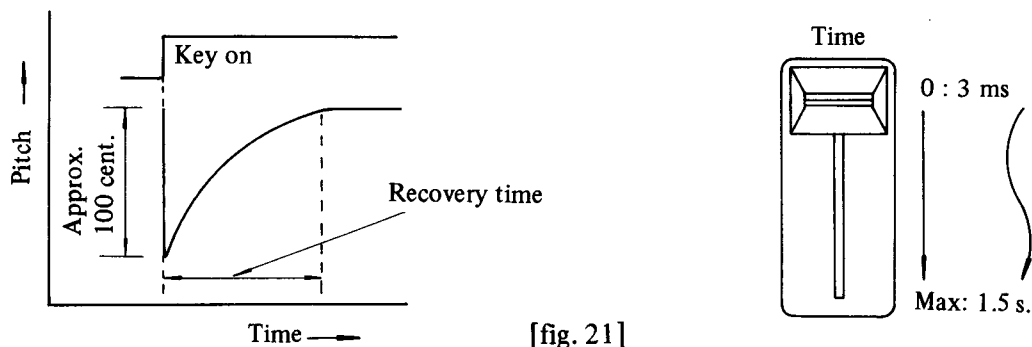
The Speed lever is used to control the speed of both Delay Vibrato and Normal Vibrato.

The Depth lever is used to control the depth of both Delay Vibrato (when set to more than 3/8 depth) and Normal Vibrato.

When Touch Vibrato is on, the Speed lever is cancelled, regardless of the Speed lever position. But if either the Depth or Delay lever is even slightly on, the Touch Vibrato effect will not function.

Attack Pitch

With this effect, at the instant a key is pressed the pitch drops approximately a half tone (about 100 cent), and then gradually rises to its correct level after a certain time (i.e., glide begins the instant key is pressed). This effect works for all tone colors, and by using the tablet it can be independently applied to upper, lower and pedals. Recovery time after the pitch drops can be controlled by the time lever.



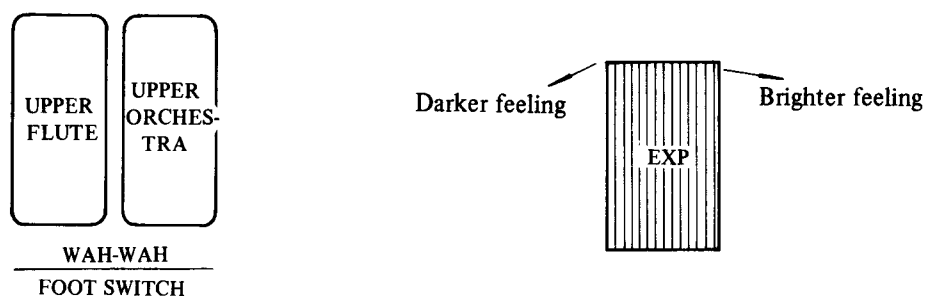
[fig. 21]

Even when the tablet is on, if the Time lever is at "0" position its recovery time is only 3 ms, which means there is hardly any effect. While Attack Pitch is functioning, all vibrato effects are cancelled; they return to their set conditions after recovery. This effect can also be obtained on the pedals together with the ABC (Auto Bass) tone pattern generation.

The Upper Time lever is used to control recovery time when Glide is on.

Wah-Wah

This control adds a Wah-wah effect to upper keyboard flute and orchestra tone. By switching the tablet on and moving the Expression Pedal right and left, Flute and Orchestra harmonic overtone elements are changed with respect to their "brightness".

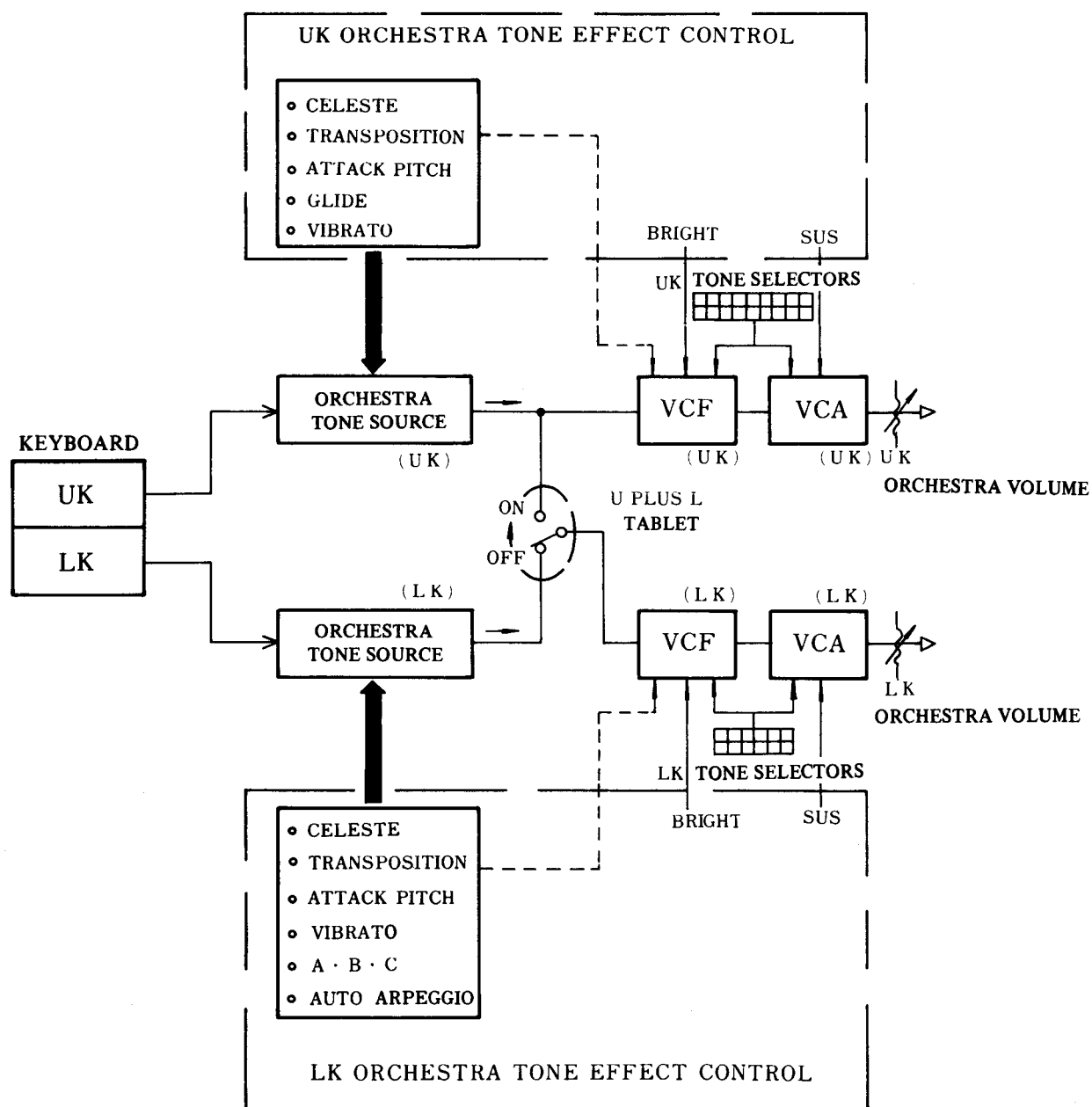


[fig. 22]

Coupler

a) Upper Plus Lower (Orchestra)

The player can combine Upper and Lower keyboard Orchestra tones by turning this tablet on and pressing upper key. At this time, Orchestra tones will not sound with lower keys but Flute tones and Flute effects sound as usual.



[fig. 23]

-
- In this case, the effects involving pitch (Glide, Attack Pitch, Transposition, Celeste, Tone Source Waveform, etc.) are controlled by the upper keyboard effects, so that corresponding lower keyboard effects do not function. However, tone color change via lower keyboard Transposition do function.
 - Levers involving tone color and volume (Bright, Volume, etc.) can be controlled on the lower keyboard as usual.
 - The Sustain effect is obtained as usual by operating the Lower Sustain tablet and lever, so that Sustain is applied to lower keyboard flute tones at the same time.
 - The Wah-wah effect does not work on the lower keyboard Orchestra tones which have been coupled to the upper keyboard.
- b) Lower Plus Pedal
- When this table is on, all pedal tones (Bass, Orchestra, Percussion) can be generated between lower keyboard C₁ and C₃ (single tones only, with precedence to higher note). In this case, no tones sound when pedals are pressed, Effects operate normaly

Percussion Levers

- a) Lower Brush Cymbal
- With this effect, each time a lower keyboard key is pressed, a short burst of white noise (hiss) is obtained. This brush tone also sounds with A.B.C. (Auto Bass Chord)
- b) Lower Snare Brush
- With this effect, each time a lower key is pressed, a rather long burst of white noise is obtained. This brush tone also sounds with A.B.C.
- c) Pedal Cymbal
- With this effect, each time a pedal is pressed, a rather long burst of white noise is obtained. This cymbal tone also sounds with A.B.C. tone generation patterns.

PANEL 2 (PN2)

Reverb Lever

This lever adds a reverb effect to all upper and lower keyboard tones.

Sustain Lever

This lever controls the length of the Sustain set for each keyboard: Upper, Lower and Pedal.

Manual Balance Lever

This lever controls the volume balance between upper and lower keyboard tones.

Auto Rhythm

These rhythms are even more interesting if used with Auto Bass Chord or Auto-Arpeggio.

Structure

- * Rhythm Select Switch
 - 14 kinds March, Waltz, Swing, Ballad, Slow Rock,
 - Jazz Rock I, Jazz Rock II, Bolero, Tango, Beguine,
 - Rhumba, Mambo, Bossanova, Samba,
- Variation
- * Start Switch
- * Synchro Start Switch
- * Tempo
- * Tempo Lamp
- * Balance
- * Volume
- (Foot Switch)
- * Operation is the same as in conventional Electones. For combination with A.B.C. and Auto-Arpeggio, refer to the explanation of each of these sections.

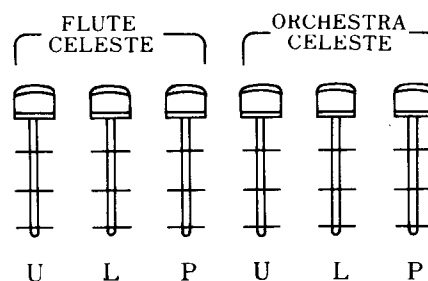
PANEL 3 (PN 3)

Celeste

By simply differing the pitches of each tone when tones from two channels are mixed, the sound can be made richer and more complex. This is called the "Celeste" effect. There are two types: Flute Celeste and Orchestra Celeste, controlled separately for each keyboard, with corresponding control levers.





This Electone has independent Flute family and Orchestra family tone sources – two for each family, providing separate Flute and Orchestra Celeste effects. (Note: The E-50 has one source for each, so the Celeste is created by combining Flute and Orchestra tones.)

Each lever for Celeste is a 4-step slide lever, and the pitch (between the two tone sources in that family) as the table shows:



[fig. 24]

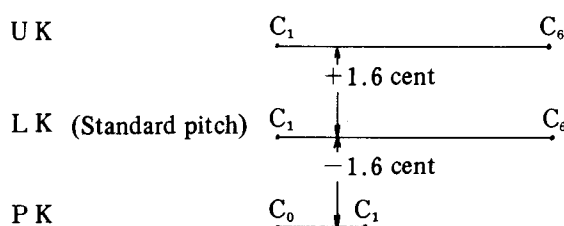
[fig. 25]

	UPPER Control lever		LOWER Control lever		PEDAL Control lever	
Lever position	Tone source		Tone source		Tone source	
	Channel I	Channel II	Channel I	Channel II	Channel I	Channel II
	0	0	0	0	0	0
	+ 1.6	- 1.6	+ 1.6	- 1.6	+ 3.2	- 3.2
	+ 3.2	- 3.2	+ 3.2	- 3.2	+ 6.4	- 6.4
	+ 6.4	- 6.4	+ 4.8	- 4.8	+ 9.6	- 9.6

(cent)

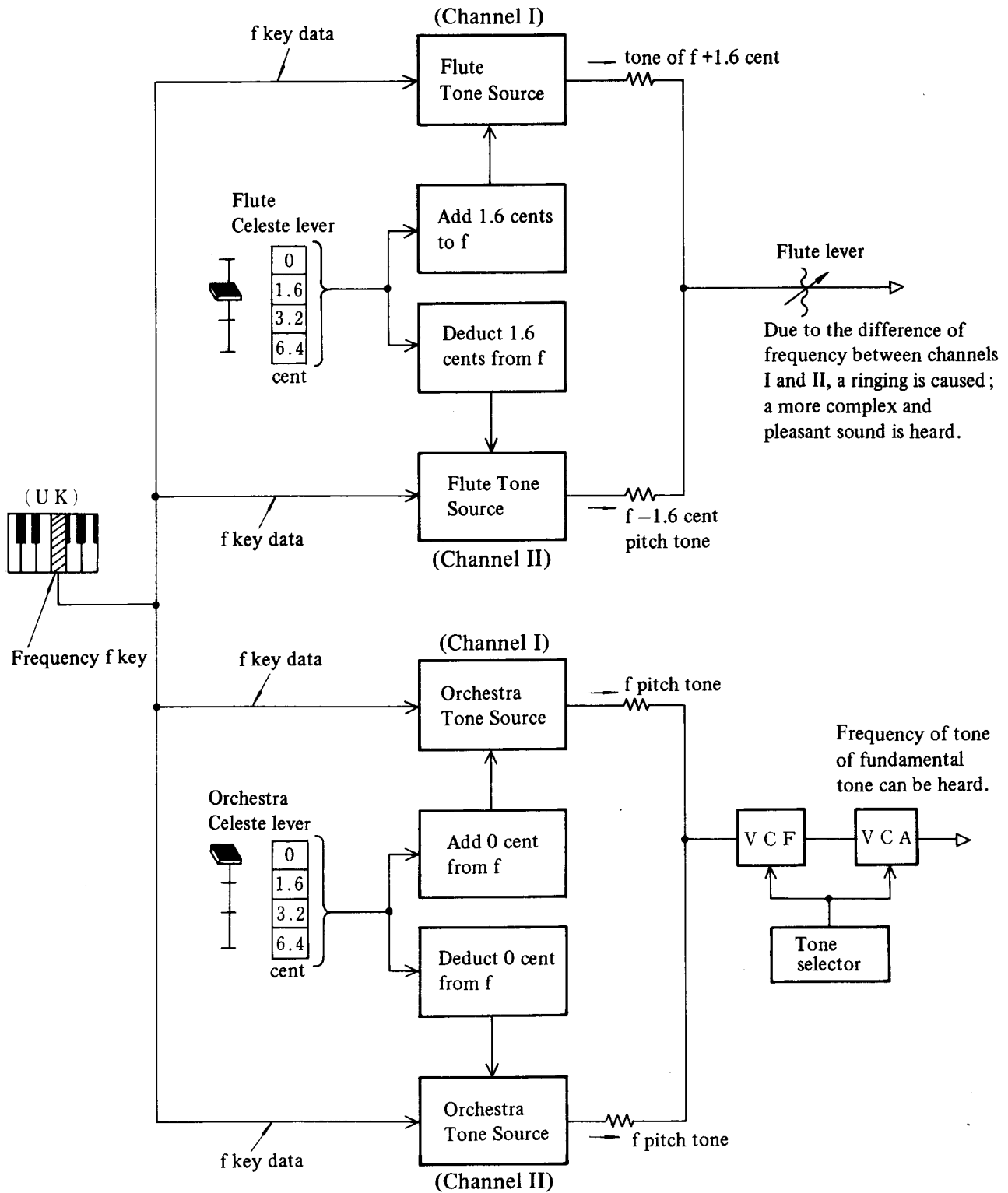
+1.6 0 -1.6
 Upper Lower Lower
 (Standard pitch)

Note: That the lower keyboard pitch is standard, and the upper or pedal keyboard tone pitch then glides ± 1.6 cents from the start. Shown below.



[fig. 26]

The Celeste effect operation chart is shown below. Tone sources, each of which has two channels, operate exactly the same way, and the tones generated are mixed into one, called by the corresponding key.



[fig. 27]

KNEE SELECTORS

The knee lever selector can be set to switch Upper Piston Cancel.

- **Upper Piston Cancel**

While playing, using (1) to (6) of the preset voices on the bottom of the upper keyboard (PN8), the preset voices can be cancelled by pressing knee lever to the right; the tone is then switched to the upper keyboard panel setting. (individual voices on preset button) (PN1)

UPPER PERCUSSIVE DECAY

When this tablet is switched on, Flute tones on the upper keyboard change from sustain types to percussive. At the same time, if the U. Sustain tablet is on, sustain takes precedence and the effect is cancelled.

U & L FLUTE RESPONSE

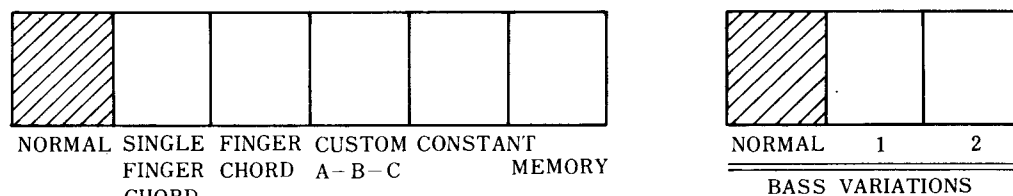
When this tablet is turned on, the beginning of upper and lower Flute notes is faster and the sound resemble an Attack effect.

PANEL 4 (PN4)

AUTO BASS CHORD (Multi-Bass)

Working together with auto rhythm, this system provides automatic bass chord variations as well as automatic accompaniment by generating lower keyboard chord in rhythmic alteration.

1. Structure



[fig. 28]

- a) Auto bass chord function switch
 - * Normal
 - * Single Finger Chord (S.F.C.)
 - * Fingered Chord (F.C.)
 - * Custom A.B.C.
 - * Constant
 - * Memory
- b) Bass variation
 - * Normal
 - * Variation 1
 - * Variation 2
- c) Auto rhythm (related switch and knob)
 - * Start
 - * Synchro Start
 - * Tempo
 - * Foot Switch
 - * Rhythm Select Switch
 - * Stop Lamp
 - * Foot Switch Select

2. Operation

- a) Auto Bass Chord Start and Tempo are controlled by Auto Rhythm Start switch and Tempo control. Therefore, when the Auto Rhythm is not switched on, the Auto Bass Chord will not function; tones will be sustained as if a constant switch had been turned on.
- b) Tones which afford A.B.C. operation
 - *Auto Bass Pedal Orchestra tones
Pedal Bass tone
 - *Auto Chord LK Orchestra tone
 - *Percussion Both lower and Pedal keyboard tones follow the A.B.C. pattern.
 - *Lower flute tones have nothing to do with the A.B.C. If it is set at on, it will sound continuously for any key held down. Also, Attack tones play as normal.

c) Bass Variations

There are three kinds: "Normal", "1" and "2".

*When note of the three selectors is pressed:

The bass tones follow the auto rhythm pattern, and strike a fundamental note (root).

*Normal: The bass tones follow the auto rhythm pattern, and strike the fundamental tone and perfect fifth higher tone.

*1 or 2: Provides bass variation times to the auto rhythm pattern.

If two or more variations are pressed at the same time, their generating patterns are combined.

(Example) Auto rhythm SAMBA
S.F.C. ON
Lower Keyboard .. C3 pressed (Major)

Bass variation

NORMAL

VARIATION 1

VARIATION 2

Bass Pattern

[fig. 29]

2-1. Single Finger Chord

Turn on the S.F.C. switch. Then, by pressing one of the lower keyboard C1 to C6 keys, the Auto Bass Chord will work with the Auto Rhythm pattern.

a) Chord detection

*When only one key on the lower keyboard is pressed, a major chord (with this note as the root) is detected.

*When two or more lower keys are played, priority for determining the root (fundamental note) goes to the C, increasing chromatically in this order: C#, D, D# B.

b) Lower chord notes

*Using the root detected as described above way (a), major 3rd and 5th notes are added and a triad is generated.

*The pitches produced will shift according to the key position pressed, and when the same note is pressed an octave higher, the chord also shifts up an octave. However, if part of the chord is out of the keyboard range, then the chord will not be produced.

(Example)

(Lower keyboard)

C1 key on Simultaneous production of C1, E1, G1

C5 key on Simultaneous production of C5, E5, G5

C6 key on Production of C6 alone

C2 & C3 keys on Simultaneous production of C3, E3, G3

- c) Selection of M (Major), m (minor), 7th (Seventh).
LK chord selection of M, m and 7th is done using the pedals.

Pedals	Type of Chord	Chord notes played	'Letter names' played
OFF	M (Major)	1, 3, 5	C, E, G
White key on	7th (Seventh)	1, 3, 7 ^b	C, E, B ^b
Black key on	m (minor)	1, 3 ^b , 5	C, E ^b , G
White & Black keys on	m7 (minor-7th)	1, 3 ^b , 7	C, E ^b , B ^b

[fig. 30]

2-2. Fingered Chord (F.C.)

When the F.C. switch is on, it detects the chord among the pressed lower keys, C₁ to C₆. Then auto bass chord operation begins, according to the auto rhythm patterns.

There is no switching with the black and white pedal keys at that time (major, minor, others).

Also, auto bass notes are produced with the bass pattern selected by auto rhythm. The initial bass tone depends upon the chord.

a) Chord detection

- The system detects the relation of either root (1) and perfect fifth (5) or root (1) and minor 7th (7^b). Moreover in addition to above detected combination, if any of second, fourth and sixth notes are detected, the chord can't be called forth.

[fig. 31]

Letter name of keys depressed	C E G
'Degree' detected	① 3 ⑤
'Chord' (root) detected	C

- When the root cannot be detected among the keys pressed, key of C has priority, then C[#], D, D[#] B. In this order a temporary root is detected and auto bass is produced.

[fig. 32]

Letter name of keys depressed	C D G
'Degree' detected	① 2 5
	7 ^b ① 4
	4 5 ①
'Chord' (root) detected	Chord not found. A temporary root is key of C. (low key priority)

- When two or more chords are detected at the same time, lowest chord (root) within the octave has priority.

Letter name of keys depressed	C E G B
'Degree' detected	① 3 5 7> C chord
	6 ^b ① 3 ^b 5> E minor chord
'Chord' (root) detected	C

[fig. 33]

Once a root is found, the root does not change until the keys are repressed or another chord is detected.

	Letter name of keys depressed	'Chord' (root) detected
When C, E and G keys were depressed	C E G	C
When C and E keys were released	G	C
When E key was pressed again	E G	E

b) LK chord

[fig. 34]

All lower keys pressed are sounded simultaneously.

Note: Lower keyboard Orchestra tone can produce at maximum of 7 tones at one time.

2-3. Custom A.B.C.

Bass sound depends on pedal key, while chord on lower key.

a) Root detection

Root detection is performed among pedal notes $C_0 \sim C_2$, and the pressed pedal note becomes the root (higher tone takes priority when two or more are pressed simultaneously).

b) Switching of M, m and 7th

Bass tone of M, m and 7th are detected in the lower keyboard. In other words, root detection is performed with pedals, and chords with the lower keyboard.

(Example)

PK	LK	Auto bass production	Auto chord notes
C_0	OFF	Key of C, M (Major)	————
C_0	C_2, E_2^b, G_2	Key of C, m (minor)	C_2, E_2^b, G_2
E_0	D_2, F_2, C_3	Key of E, 7th	D_2, F_2, C_3

[fig. 35]

c) Lower chord tones

Tones played on the lower keyboard sound as long as the corresponding keys are held down.

d) Auto bass tones

Auto bass tones are produced with the root selected by pressing a proper pedal. The interval is decided according to the auto rhythm pattern. Initial tone depends upon which pedal key is pressed.

(Example) When C_0 is pressed, if the beginning of the measure was C_0 (or C_1)

C_1 PK on the first tone of the measure is C_1 (or C_2)

C_2 PK on the first tone of the measure is C_2 (or C_3) will be produced.

2-4. Constant

a) When the Constant switch alone is turned on, the condition is the same as normal play.

b) When one of A.B.C. tablets is turned on as well as the Constant switch, chord detection is performed in the same way as for each auto bass, but tones are produced (continuously) only as long as their keys are held down; this is, has nothing to do with the rhythm. The first bass tone of the measure, as decided according to chord, is produced continuously.

Note: For each tone color, sustaining tones are continuous and attenuating tones are produced once only when pressed.

2-5. Memory

- a) When the Memory switch alone is turned on, the condition is the same as Normal. This Memory switch has an A.B.C. Memory function while the auto rhythm is working; when used together with Constant, it provides a memory without interfering with the auto rhythm.
- b) When the memory switch is on:
- S.F.C. : On
Single finger chord operation is provided, and even when the key is released the condition continues.
 - F.C. : On
Finger Chord operation is provided; even when the key is released, auto bass tones, auto rhythm tones and pedal percussion stay as they are.
(Lower chord tones do not continue)
 - Custom : On
Custom A.B.C. operation is provided; when a pedal key is released, auto bass tones, auto rhythm tones and pedal percussion are continued as they are.
(Lower chord tones are produced only while lower keys are held down.)
 - Constant + (A.B.C.): On
This is a Constant condition (sustained tones); even if the hands are removed from the keyboard the condition continues.

Note: Then the auto rhythm is stopped, the memory is cleared.

2-6. Priority Order

In A.B.C. functions, the selector farthest to the right has priority. The order is: Custom – Fingered Chord – Single Finger Chord.

2-7. A.B.C. and Auto Rhythm Synchro Start and Stop Operations (Memory: off)

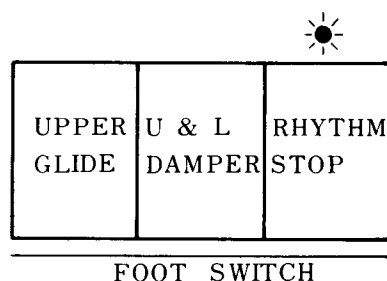
- S.F.C. or F.C.: On
Synchro Start begins when a lower key is pressed; auto rhythm is produced only while a lower key is pressed.
When all lower keys are released, auto rhythm stops; when a lower key is pressed again, the rhythm starts from its first beat.
 - Custom: On
Synchro Start begins either by pressing a pedal or lower key; it stops when the last pedal or lower key is released.
- * With the Synchro-Start switch on and the rhythm started, if the player presses a lower key (or pedal, in the case of Custom) auto rhythm and A.B.C. start from the beginning of the measure.

2-8. Relationship between A.B.C. and Auto Arpeggio

- When Auto Bass Chord is turned on, even though Arpeggio of the lower Orchestra tone is already on, auto bass chord takes priority.
- Lower keyboard flute tones can have the arpeggio effect independent of auto bass chord.
- When the memory is on together with S.F.C., even though the lower key is released, flute tones can have the auto arpeggio with a three-tone pattern.

FOOT SWITCH SELECTORS

This selector switches let the player choose the functions of Glide, Damper and Rhythm Stop, by operating the foot switch.



[fig. 36]

1. Upper Glide

By turning on this tablet and operating the foot switch, tones from the upper keyboard (both flute and orchestra) drop by a half tone (100 cents).

By returning the foot switch to the original condition, the pitch also returns to the original tone. At this time, the more the Attack Pitch (time) lever on the main panel is pulled toward the player, the slower the pitch returns to normal.

2. U & L Damper

Ordinarily "Damper" effect means cutting tones, but here it works via the following three functions.

- a) When Vibraphone (an upper preset tone), is on, if the player turns on this Damper switch and releases a key, the tone stops right away. But with operation of the foot switch, the tone returns to its original condition. (attenuating tone)
- b) For flute tones (both upper and lower keyboards), by turning on Damper switch and operating the foot switch, the player can obtain exactly the same function as Sustain. (The length of sustain is decided by the Sustain Control lever.)

However, if the sustain effect is being provided via the Sustain tablet, then turning on the Damper switch will cancel the sustain effect; but then, if the foot switch is operated, the Sustain effect can be created once again.

3. Rhythm Stop

If the Rhythm Stop switch is turned on, when the foot switch is moved once, the auto rhythm stops; when the foot switch is moved again, the auto rhythm begins anew.

TREMOLO

For tremolo and chorus effects, the conventional method of revolving speakers is changed. Now the sound produced by a cone speaker (20 cm) for tremolo effect is deflected by a special Yamaha revolving foamed polystyrene drum, for a more natural and deep effect.

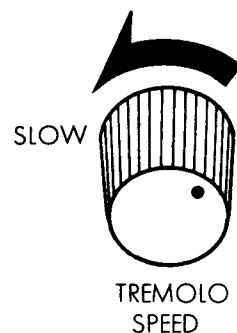
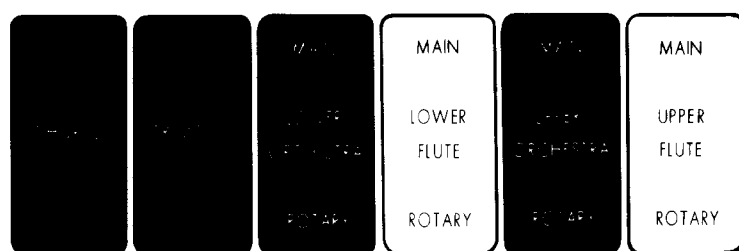
1. Structure

Control tablets:

- Chorus
 - Tremolo
 - Upper Flute (Main/Rotary)
 - Upper Orchestra (Main/Rotary)
- Control knob
- Tremolo Speed

2. Operation

- When either the Chorus or Tremolo tablet is turned on, the revolution drum begins to turn.
- For voice switching, upper keyboard and lower keyboard, as well as flute and orchestra types can be turned on separately.
- Neither the tremolo nor the chorus effect works with auto rhythm, pedal tones or percussion.

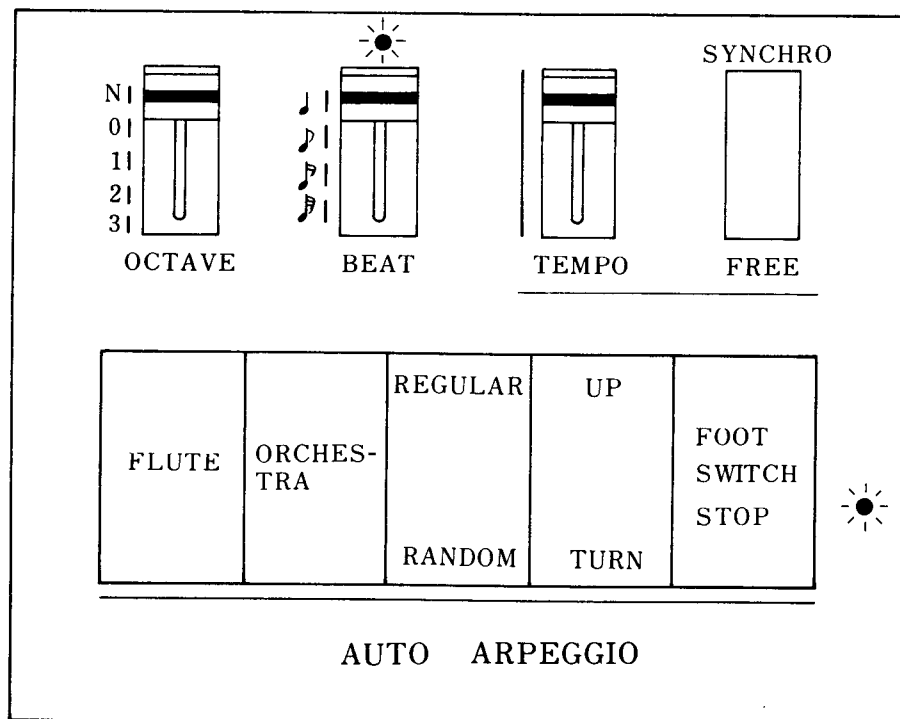


[fig. 37]

PANEL 5 (PN5)

AUTO ARPEGGIO

Auto arpeggio is an effect which works only with lower keyboard notes. The lower key pressed by the player is arranged by the tablets and levers shown below, and the system automatically repeats the notes keyed on the lower keyboard as set.



[fig. 38]

1. Flute Tablet

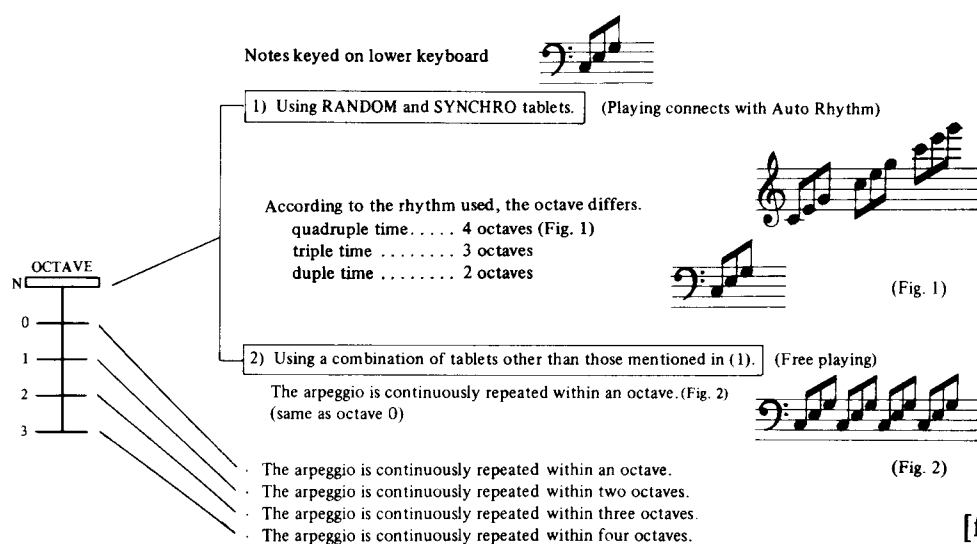
If this tablet is on, when lower keys are pressed, the arpeggio effect works with the flute tones. At this time, tones become percussive tone (attenuating tone).

2. Orchestra Tablet

When this tablet is on, lower keyboard orchestra tones create an arpeggio effect.

3. Octave Lever

This lever is used to set the octave range for the arpeggio effect. Arpeggio effect is expressed by the position of the lever within the range shown in next page. However, when the lever position is "N", the arpeggio effect tone range can change because of other tablet settings (Free and Random).



4. Synchro/Free Tablet

When this switch is off, i.e., in Synchro condition, the tempo of the Arpeggio follows the auto rhythm. When the player does not want to interlock with the auto rhythm, this switch should be set to Free side.

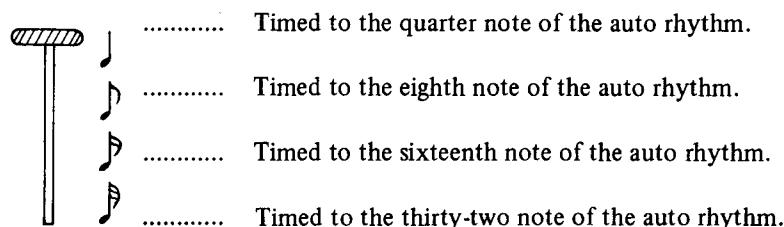
5. Tempo Lever

This lever is used to control the arpeggio speed; it is used with the Free tablet. The further forward the lever is pulled, the faster the tempo becomes.

6. Beat Lever

An arpeggio, even with the same tempo, can give quite a different feeling by changing its beat. This lever sets notes which are used to form the Arpeggio.

When Synchro/Free tablet is off, the tempo of the Arpeggio follows the auto rhythm.



[fig. 40]

7. Beat Lamp

When Arpeggio switches for Flute or Orchestra are turned on, this lamp flashes with each quarter note, regardless of the beat selected.

8. Regular/Random Tablet

This switch selects the form of the arpeggio. It is usually on Regular; the Random mode occurs when the tablet is on.

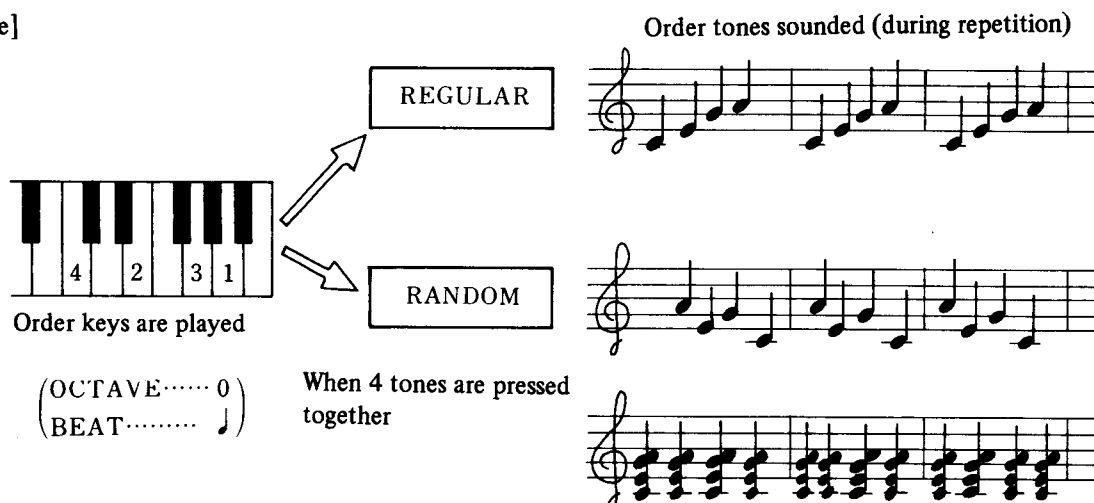
- Regular Mode

This is a mode which regulates the order of notes from the lowest, even if many keys have been pressed at the same time.

- Random Mode

This allows the replaying of notes retaining their original timing and order (that is, notes are kept in the same condition as they were played). It is the same when tremolo, chords and broken chords are played.

[Example]

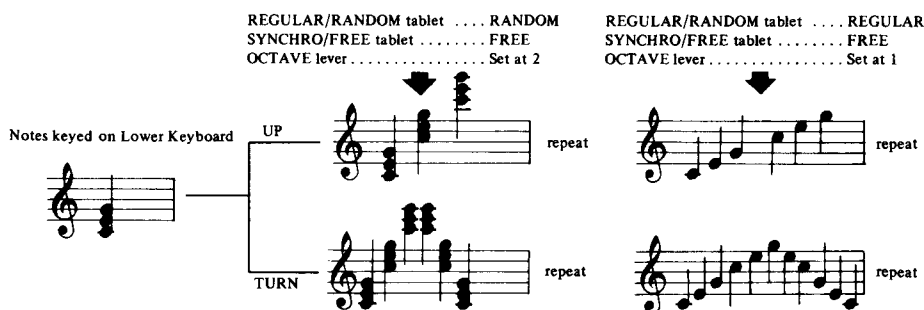


[fig. 41]

9. Up/Turn Tablet

When this tablet is off (Up), the arpeggio effect is repeated from the bottom of the top of the range set by the octave lever. When the tablet is set to Turn, the arpeggio pattern first plays up to the top of this range, then back down to the original tone.

[Example]



[fig. 42]

10. Foot Switch Stop Tablet

By turning this tablet on and using the foot switch, the arpeggio effect can be cancelled; then the tones being pressed on the lower keyboard will be a sustained tone.

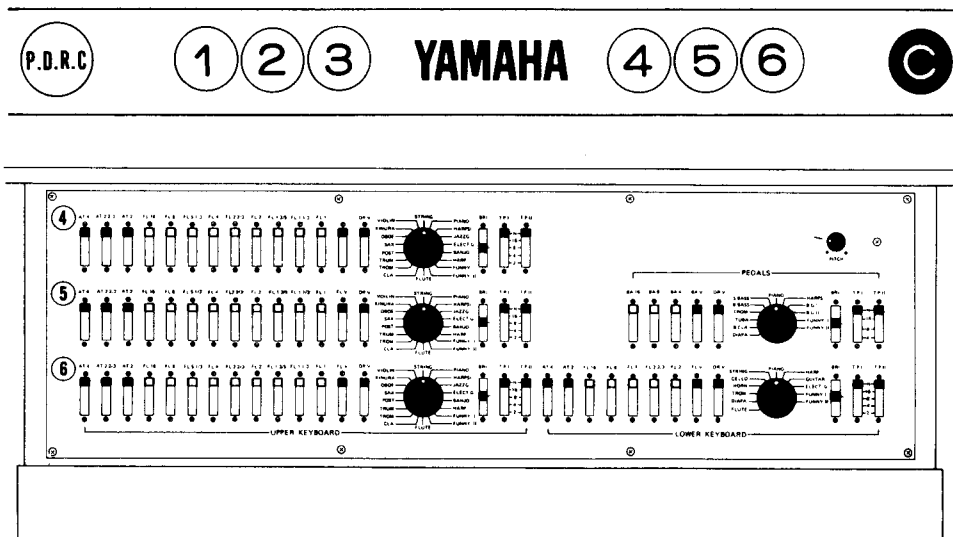
When the foot switch is operated again, the original arpeggio effect returns.

11. Foot Switch Stop Lamp

When this tablet is on and the foot switch turned on, the lamp also lights.

PANEL 6 / PANEL 7 (PN6 / PN7)

PRESET VOICES (PRESET PISTONS)



These are set with the piston buttons and preset board (PN7) under upper keyboard (PN8). There are six kinds, (1) to (3) preset on the fundamental board, and (4) to (6) which allow the player to select the tone color.

1. Fixed Preset Pistons 1 ~ 3

- Piston 1 : Jazz organ voice with attack
 - UK : Flute 16' 8', 5-1/3', Attack 2-2/3'
 - LK : Flute 8', 4'
 - PK : Bass 8'
- Piston 2 : Full organ voice having a great deal of depth
 - UK : Flute 16', 8', 4', 2', 1'
 - LK : Flute 8', 4' Orchestra Horn
 - PK : Bass 16'
- Piston 3 : "Theater sound" voice
 - UK : Flute 16', 8', 4', 2', 1', Orchestra Violin
 - LK : Flute 8', 4', Orchestra Cello
 - PK : Bass 16', 8', Orchestra Bowd Bass

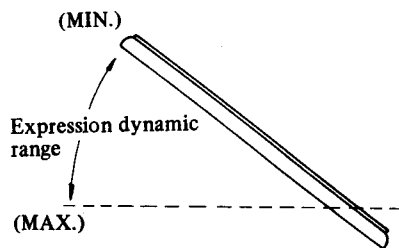
2. Preset Pistons 4 ~ 6 (Freely set on preset board)

See the illustration above.

- Piston 4 & 5 : UK setting on preset board
- Piston 6 : All keyboard setting on preset board

Note) Among preset pistons 1 to 6, right-hand buttons take priority (i.e., 6 has top priority), and when the cancel C button is pressed, the tone color switches to that the panel. Effects which work on main panel also work on all preset voices.

Pedal Dynamic Range Control Piston



[fig. 44]

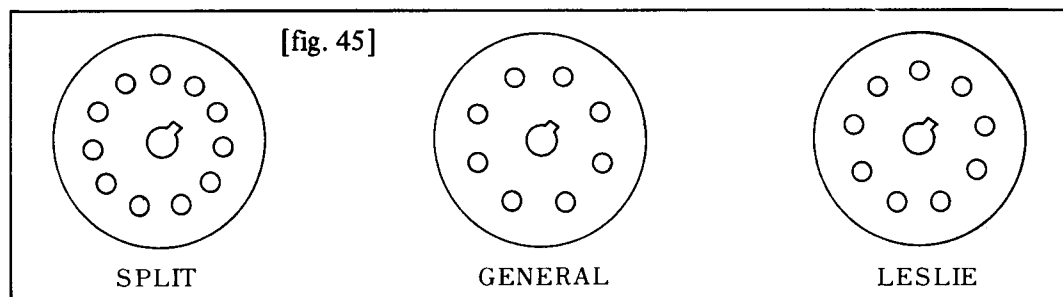
When the piston is pressed, the lamp goes on and the dynamic range expression of pedal tones becomes amp. 20dB, (with the Exp. pedal at minimum, tones can still be heard). However, Percussion is not affected. If the piston is pressed again, the lamp goes out and the range returns to its original condition.

Pitch Control Knob

This is on the preset board, and controls upper & lower keyboards and pedals at the same time. Adjustment range: -3 to +20 cents.

Tone Cabinet Connectors

On the back of the main body there are three (or two) tone cabinet connectors to allow use of external speakers.



11 pin connector; can be used for a tone cabinet with electronic tremolo.

Same as a conventional 8-pin connector; for use with a tone cabinet incorporating tremolo, such as the R-60B.

For direct connection of a Leslie speaker (700 type or 710 type).
(USA and Canadian Models only)

{ Output impedance: 500Ω
Maximum output level: 5V p-p

Foot Switch

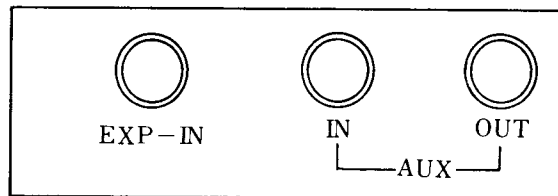
This switch is operated by lightly turning the whole expression pedal to the left. It has the following functions:

- Upper Glide
 - U & L Damper
 - Rhythm Stop
 - Upper Flute Wa-Wah
 - Upper Orchestra Wah-Wah
- } Interlock with the foot switch selector tablet
- } Interlock with each tablet

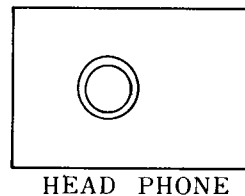
(Note: Wah-wah is an exception; the foot switch is turned lightly right and left to control it.)

Additional Terminals

Under the lower keyboard.



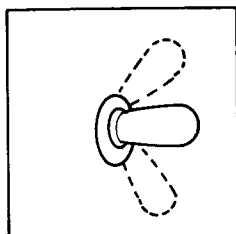
[fig. 46]



- Exp-In: Input terminal for synthesizer, etc.; volume change is controlled by the Exp. pedal.
 { Input impedance: 50 k Ω
 { Maximum input level: -20 dBm
- Aux-In: Input terminal independent of the Exp. pedal
 { Input impedance: 30 k Ω
 { Max. input level: -10 dBm
- Aux-Out: Output terminal to be used when Electone sounds are recorded on to tape, etc.
 { Input impedance: 600 Ω
 { Max. output voltage: 500 mV

Panel Light / Pedal Light Switch

Using this switch, the player can turn the five built-in panel lights and the pedal light on and off. There are also two different on positions.



- Turned to the back: dim light
 (except North European, European and BS Models)
- Center: off
- Turned forward: bright light

[fig. 47]

III. EXPLANATION OF PAS-FORMANT MODEL E-30

1. SPECIFICATIONS.

1. Keyboards

- a. Upper: 61 keys (C₁ ~ C₆)
- b. Lower: 61 keys (C₁ ~ C₆)
- c. Pedals: 25 keys (C₀ ~ C₂)

2. Tone Levers

- a. Upper: Flute 16', 8', 5-1/3', 4', 2-2/3', 2'
Diapason 8', Bassoon 16', Brass 8',
Oboe 8', Kinura 8', String 8', 4',
Attack 4', 2-2/3'
- Lower: Flute 8', 4', 2-2/3', 2', Diapason 8', Horn 8', Cello 8', 4'
- c. Pedals: Bass 16', 8', Tuba 16', String Bass, Bass Guitar

3. Effect Levers

Brilliance (upper, lower)
Touch Vibrato (upper)
Delay Vibrato (upper)
Vibrato Depth (upper & lower)
Vibrato Speed (upper & lower)
Attack Length (upper)
Attack Wah-Wah (upper)
Repeat Speed (upper)

4. Effect Controls

Manual Balance (upper, lower)
Reverb (upper, lower)
Upper Sustain (upper)
Lower Sustain (lower)
Pedal Sustain (pedal)

5. Effect Tablets

Upper Sustain
Lower Sustain
Upper Percussive Decay
Response

6. Tremolo

Tablets: Chorus, Tremolo, Lower Voice, Upper Voice, U & L Flute
Control: Tremolo Speed Control

7. Upper Orchestra

Trombone, Saxophone, Guitar, Accordion, Trumpet, Clarinet, Banjo, Wah-Brass, Ensemble, Volume, Bright

8. Upper Preset

Piano, Harpsichord, Hawaiian Guitar, Chimes, Vibraphone, Full Ensemble

9. Preset Pistons: 1, 2, 3, Cancel

10. Auto Rhythm

14 Rhythm: March, Waltz, Swing, Ballad, Slow Rock, Jazz Rock I, Jazz Rock II, Bolero, Tango, Beguine, Rhumba, Mambo, Bossanova, Samba Variation

Rhythm Controls:

Start, Synchro Start, Tempo Control, Volume Control, Balance Control, Tempo Lamp

11. Auto Bass Chord

Function Switches: Normal, Single Finger Chord, Fingered Chord, Custom ABC, Constant, Memory

Bass Variations: Normal, 1, 2

12. Auto Arpeggio

Start, Octave, Tempo Lamp, Beat, Up/Turn

13. Others

Master Volume

Expression Pedal

Panel Light Switch

Power Switch, Door Switch

Upper Piston Cancel

Pilot Lamp

Knee Lever

Foot Switch (Rhythm Stop, Glide, Auto Arpeggio Stop, Damper)

Tone Cabinet Connectors

Pin Jack (Exp In, Aux In, Aux Out)

Headphone Jack

14. Main Amplifier

60W x 2 (8 Ω load)

15. Speakers

Main Speakers: JA3052B, JA2057A, JA05530

Tremolo: JA20610

16. Tremolo Motor:

Single Phase 14 pole capacitor drive induction motor (electronic speed control)

17. Power Consumption

270 W (AC 117V, 50/60 Hz), 2.7A

18. Cabinetry

Main Cabinet: American Walnut Grain Finish (CSP)

Width: 1,304 mm

Depth: 737 mm

Height: 1,076 mm (1,266 mm with music stand raised)

Weight: 124 kg

Bench: American Walnut Grain Finish (CSP)

Width: 1,016 mm

Depth: 411 mm

Height: 600 mm

Weight: 16 kg

Pedals: American Walnut Grain Finish (CSP)

Width: 1,216 mm

Depth: 823 mm

Height: 135 mm

Weight: 22 kg

19. LSI Sheets: 16

20. IC Sheets: 26 (2 power units)

21. Transistor

Sheets: 138 (46 FETs)

Main Amp: 14

Power unit: 3 (FET)

22 Diode

Sheets: 196

Main Amp: 4

Power Unit: 8

2. E-30 POINTS DIFFERING FROM E-70

1. Tone Color

- Orchestra Tones (8 tones) only on upper keyboard, no transposition.
- Flute or Orchestra tone have one tone source.
- Piano, Harpsichord and Hawaiian Guitar are added as upper preset tones.
- Upper, Lower and Pedal tone levers consist of not only the Flute family, but also the conventional String, Oboe, Horn and Bass Guitar.
- Preset voices (piston) 1, 2, 3 : UK voices are preset at the factory.

Piston 1

A Jazz Tone sound incorporating
Flute 16', 8', 5-1/3', Attack 2-2/3'

Piston 2

A Flute Ensemble sound incorporating
Flute 16', 8', 4', 2'

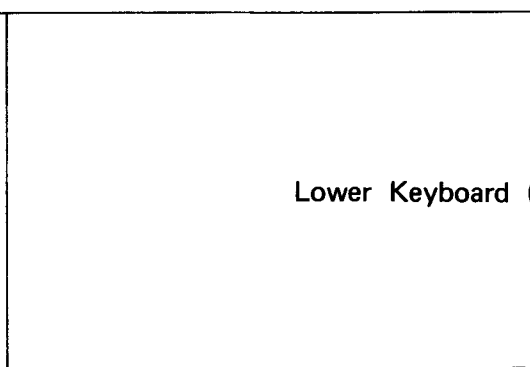
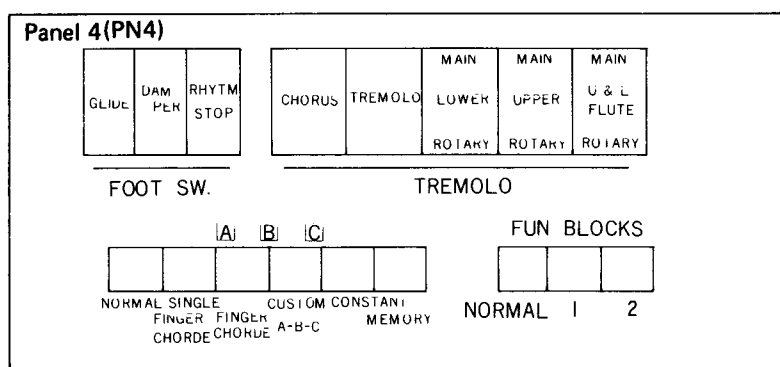
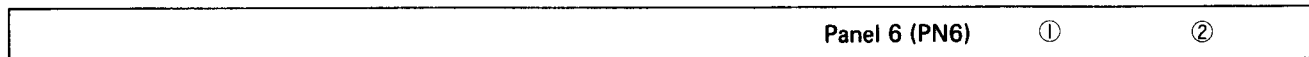
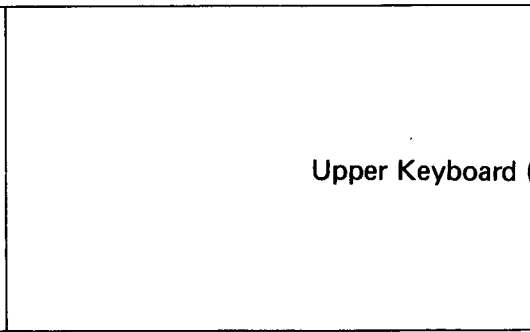
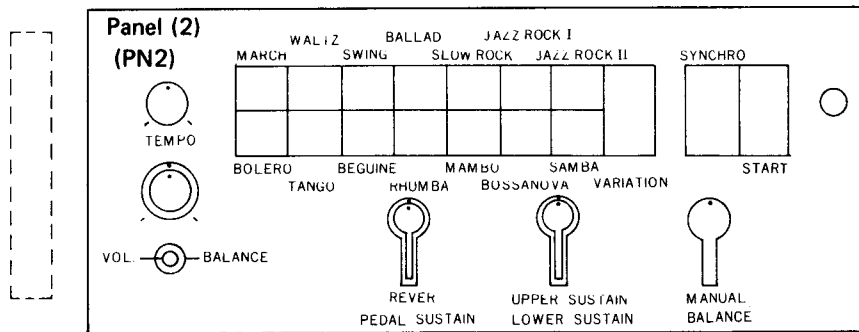
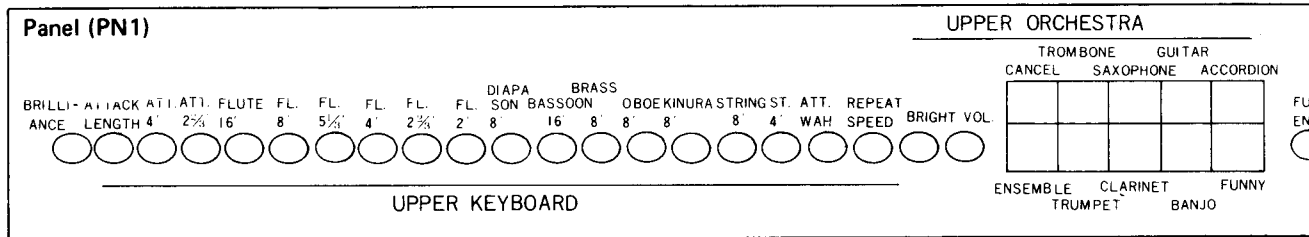
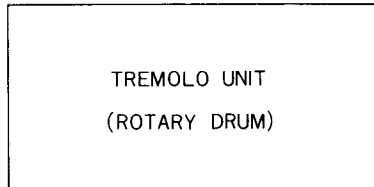
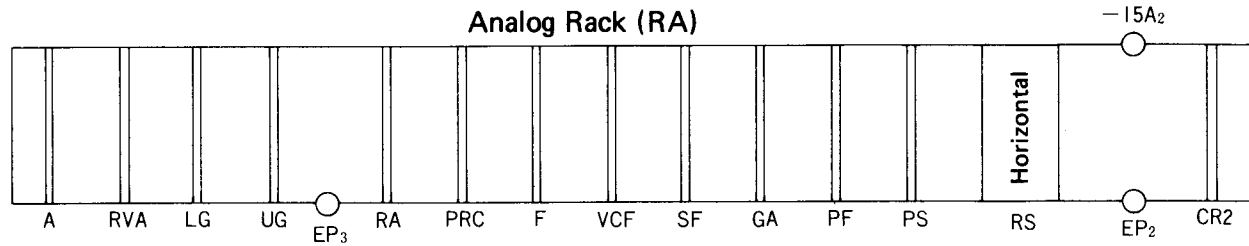
Piston 3

A Full Organ sound incorporating
Flute 16', 8', 4', 2', Bassoon 16', Kinura, String 8'

2. Effects

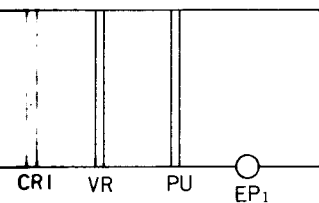
- Celeste, Wah-Wah, Couplers, Attack Pitch, etc. are not included.
- Tremolo Chorus
 - Lower (Main/Rotary) Tablet
 - When this tablet is set to Rotary, the tremolo effect is applied to all lower keyboard tones.
 - Upper (Main/Rotary) Tablet
 - When this tablet is set to Rotary, the tremolo effect is applied to all upper keyboard tones.
 - U & L Flute (Main/Rotary)
 - When this tablet is set to Rotary, the tremolo effect is applied to all upper and lower keyboard Flute tones.
 - However, if the Upper and Lower Rotary tablets are set, then all tones other than Flute will sound through the main speaker and the Tremolo effect will be lost.
- Auto Arpeggio
 - Start Tablet
 - When this tablet is switched On, lower keyboard tones will sound with the Auto Arpeggio effect (this effect is the same as that on the E-70).
 - Tempo & Synchro/Free not included.
 - The E-30 Auto Arpeggio is tied into the Auto Rhythm section, so the tempo is set with the Auto Rhythm control.
 - Damper
 - Damper effect is not connected with the flute tones.

3. PANEL LAYOUT (MODEL E-30)

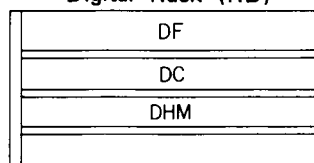


Pedals (PK) 25 KEYS C₀ ~ C₂

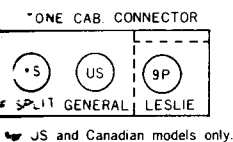
Pa
po



Digital Rack (RD)



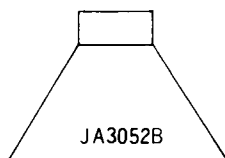
MO



(Midrange)



(Tweeter)

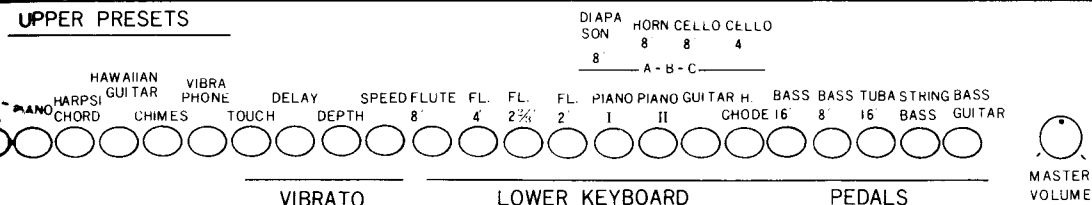


(Woofer)

Door switch (DSW)

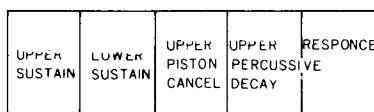
(Not required for N. Europe and BS models)

UPPER PRESETS



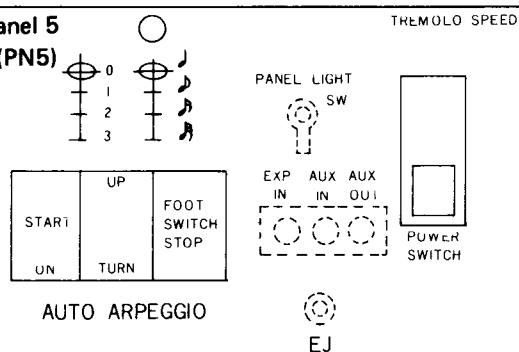
UK) 61 KEYS C₁ ~ C₆

Panel 3 (PN3)



UK) 61 KEYS C₁ ~ C₆

Panel 5 (PN5)



PA1 (NON. TRE.)
ND6060
60W

PA2 (TRE.)
ND6060
60W

Panel light
Power unit



FOOT SW.

EXP.



KNEE LEVER

Power unit
NP 6007Z

[fig. 48]